

# *Update my dynaco*



## ***Dynaco PAT-5 Preamp Power Supply (PAT5PM15) +/-15 Volts only ASSEMBLY MANUAL***

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Revision 1p08      March 27, 2021

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## Section 1: About This Manual

This manual gives the information needed to build and install the upgraded power supply for Dynaco's PAT-5 Preamp. This upgrade changes out the power supply PCB but keeps the power supply transformer, with the following advantages over the original power supply:

- Lower noise
- Lower output impedance
- More efficiency, runs cooler, promotes longer life of the electronics

Use this power supply, the PAT5PM15, if you are using Updatemydynaco line stages and phono stages. This power supply does generate +/-15 volts, but it doesn't generate the 42 volts required by the original PAT-5 phono preamp. If you're keeping the original PAT-5 phono preamps, you'll want to use the PAT5PWR supply that we make.

**Important Note: this kit and the transformer are only compatible with 120 VAC power.**

### **Who Should Attempt this Project?**

You can build this kit if you can:

1. Solder (using normal rosin core solder and a soldering iron).
2. Use simple hand tools like screwdrivers, wire cutters, and pliers.
3. Read and follow directions.

It helps if you:

1. know a bit about electronics, or
2. have a friend who knows a bit about electronics
3. can get to YouTube to watch a few helpful videos about the assembly process (none are posted as of this version of the manual).

### **Tools you'll need**

You'll need the following tools:

1. Phillips screwdriver (#1 and #2), regular screw-drivers.
2. Pliers or nut drivers suitable for #4 and #6 hardware
3. needle nose pliers (helpful, but not strictly necessary)
4. pencil type soldering iron of 25 to 50 Watts (no huge honking soldering guns or blowtorches)
5. wire cutters and strippers
6. multi-meter to measure power supply voltages and confirm resistor values (strongly recommended)!

### **Helpful Tools**

These tools aren't strictly necessary but make building the kit easier.

1. magnifying glass, if you're over 42!
2. lead bending jig to form axial component leads to the correct span for insertion in the PCB.

## ***Project Overview***

The project consists of the following steps:

1. Building the circuit board.
2. Removing the old power supply
3. Installing and testing the new power supply
4. Completing re-assembly of the preamp.

## ***Important Safety Notes***

By purchasing, using, or assembling this kit, you have agreed to hold Akitika LLC harmless for any injuries you may receive in its assembly and/or use. To prevent injuries:

- Wear safety glasses when soldering or clipping wires to prevent eye injuries.
- Always unplug the power before working on the amplifier.
- Large capacitors hold lots of energy for a long time. Before you put your hands into the amplifier:
  - Pull the AC plug!
  - Wait 2 full minutes for the capacitors to discharge!
- Remove jewelry and rings from your hands and wrists, or anything that might dangle into the amplifier.
- If working on the equipment with the power on, keep one hand in your pocket, especially if you're near the power supply or power supply wires. This can prevent serious shocks.
- Build with a buddy nearby. If you've ignored all the previous advice, they can dial 911 or get you to the hospital.
- Read and understand the safety manuals of all the tools you use.

## ***About Components***

We reserve the right to make design/or component changes at any time without prior notification.

## ***Recommended Solder***

The kit must be assembled with 63/37 Rosin Core solder<sup>1</sup>. The recommended diameter is 0.032 inches.

## ***Warranty***

With the exception of fuses, Akitika LLC will replace for free any parts of a correctly assembled product that fails within one year of the date of purchase when the equipment has been used in home stereo applications. It is the responsibility of the kit builder to install the replacement part(s). This warranty applies to the original purchaser only. It does not apply to units that have been physically or electrically abused, modified without prior factory authorization, or assembled with other than 63/37 Rosin Core solder. Akitika LLC's liability shall in no event exceed the cost paid to Akitika LLC for the kit.

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<sup>1</sup> 60/40 solder is also available, but according to Wikipedia, 63/37 solder is preferred as it is less likely to have a "cold" solder joint.

## Section 2: Kit Building Hints

Yes, I know you want to ignore this section, and jump right into building the kit. However, please ***take a minute and read the advice of this section.*** I've condensed it into bullets so that even you guys who are in a hurry can benefit.

- Stop any time you're feeling confused, tired, or anxious. Taking breaks at those strategic times will keep the build enjoyable and greatly enhance your chances of first-time success.
- A soup bowl is your friend. Before you build a board, carefully empty the parts into a broad, flat, light colored soup bowl. That makes it easy to find the parts and keeps them from getting lost.
- A digital ohm-meter is an easy way to make sure that you've picked the right resistor. It's a great cross-check on the resistor color code. Measure twice and solder once!
- A lead-bending jig can make for quicker, neater assembly. It's certainly not necessary.
- Is something in this manual confusing? Does something look wrong? Send your questions by email to [dan@akitika.com](mailto:dan@akitika.com) or [dan@updatemydynaco.com](mailto:dan@updatemydynaco.com). You'll help yourself and everyone who builds the kit.

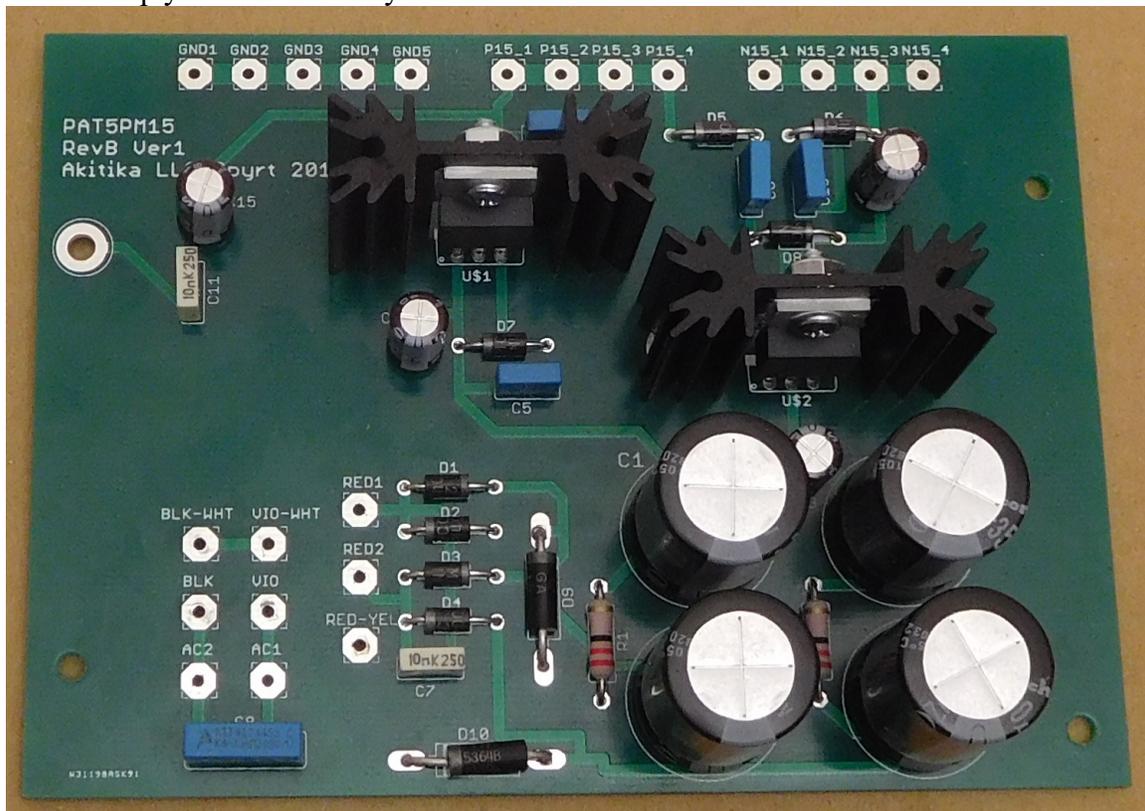


Figure 1-Assembled PAT-5 Power Supply



## Component Order

You'll notice that the component designations in the directions don't go exactly in order. We have grouped them so that all components with the same value appear together. This makes assembly easier. You'll find in the parts kit that similar parts, e.g. 8 1N4004 diodes, are typically (though not always) taped together.

## Install the diodes

In general, you install axial leaded components (like the diodes) by placing the body on the silk screen side of the board, and the leads through the indicated holes. Bend the leads over on the back of the board to keep the components from falling out until your solder them in place. Try to bend the leads in a direction that won't lead to solder bridges between traces that should remain disconnected.

We recommend the following procedure:

1. Insert all components of the same value or type
2. Bend the leads as described above.
3. Solder the leads on the back of the board.
4. Clip the leads.

Track your progress by placing a checkmark in the done column as you install each component.

Diodes are polarized, having an anode and a cathode. When you insert the diode, match the banded end of the diode to the banded end of its representation on the silk screen.

<i>Diodes – watch the polarity! – bend leads to 0.4" width</i>			
Designation	Type	Rating, Marking, Description	Done? (✓)
D1	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D2	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D3	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D4	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D5	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D6	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D7	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D8	1N4004	400 PIV 1 Amp, 1N4004, rectifier diode	
D9	1N5364	33 Volt, 5 Watt Zener Diode	
D10	1N5364	33 volt, 5 Watt Zener Diode	

## Install the Resistors

Bend resistor leads to 0.5" width			
Designation	Value	Color Code	Done ✓
R1	22	Red, red, black, gold (1 Watt, 5%)	
R2	22	Red, red, black, gold (1 Watt, 5%)	

## Install the non-polar Capacitors

These capacitors are not polarized, so it doesn't matter which way they are installed on the printed circuits.

Designation	Value	Description	Done ✓
C5	0.1 $\mu$ F	100 Volt, film	
C6	0.1 $\mu$ F	100 Volt, film	
C9	0.1 $\mu$ F	100 Volt, film	
C10	0.1 $\mu$ F	100 Volt, film	
C7	0.01 $\mu$ F	400 Volt, film	
C11	0.01 $\mu$ F	400 Volt, film	
C8	0.033 $\mu$ F	300 Volt Safety Cap, film	

## Install the Polarized Electrolytic Capacitors

These capacitors have a polarity. If you put them in backwards:

- The power supply won't work
- The capacitors may explode sending their insides racing to the outside

**Please re-read the above sentence, and double check the capacitor polarity before you solder them in place!**

Please double check the polarity of each capacitor upon installation			
Designation	Value	Description	Done ✓
C12	47 $\mu$ F	35 Volts, electrolytic	
C13	47 $\mu$ F	35 Volts, electrolytic	
C14	47 $\mu$ F	35 Volts, electrolytic	
C15	47 $\mu$ F	35 Volts, electrolytic	
C1	2200 $\mu$ F	35 Volts, electrolytic	
C2	2200 $\mu$ F	35 Volts, electrolytic	
C3	2200 $\mu$ F	35 Volts, electrolytic	
C4	2200 $\mu$ F	35 Volts, electrolytic	

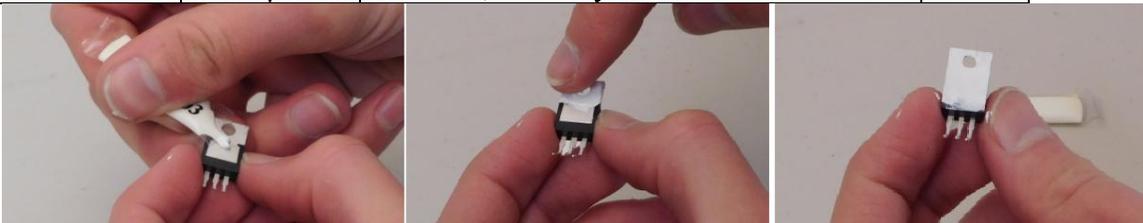


Figure 4-Applying thermal compound

## Install the TO-220 Regulators and Heatsinks

There are two regulators, both in TO-220 packages. **Be warned...they are different, and they are not interchangeable. Make sure you double check your work before you solder them in place.**

1. Start with U\$1, the  $\mu$ A7815. Spread a thin film of heatsink compound on the back of the regulator, see Figure 4.

2. Fasten the regulator to the heat-sink using a 4-40x5/16" Phillips head screw and 4-40 keps nut (a nut with a built-in lock washer) as shown in Figure 5.
3. Insert the regulator/heat-sink assembly into the PCB.
4. Turn the board over and solder the cylindrical projections of the heatsinks to the circular pads on the bottom of the PCB. This will take a lot of heat and solder.
5. Solder the 3 leads of the regulator to their associated pads.
6. Repeat the above process for U\$2, the LM7915.

Figure 5 shows the details of the mounting screws and soldering the heat-sink posts on the bottom of the board.

Please double check the regulator type upon installation			
Designation	Value	Description	Done
U\$1	$\mu$ A7815	Positive 15 Volt Linear Regulator	<input checked="" type="checkbox"/>
U\$2	LM7915	Negative 15 Volt Linear Regulator	<input type="checkbox"/>



Figure 5-Regulator and Heat Sink mounting screws and soldering mounting posts

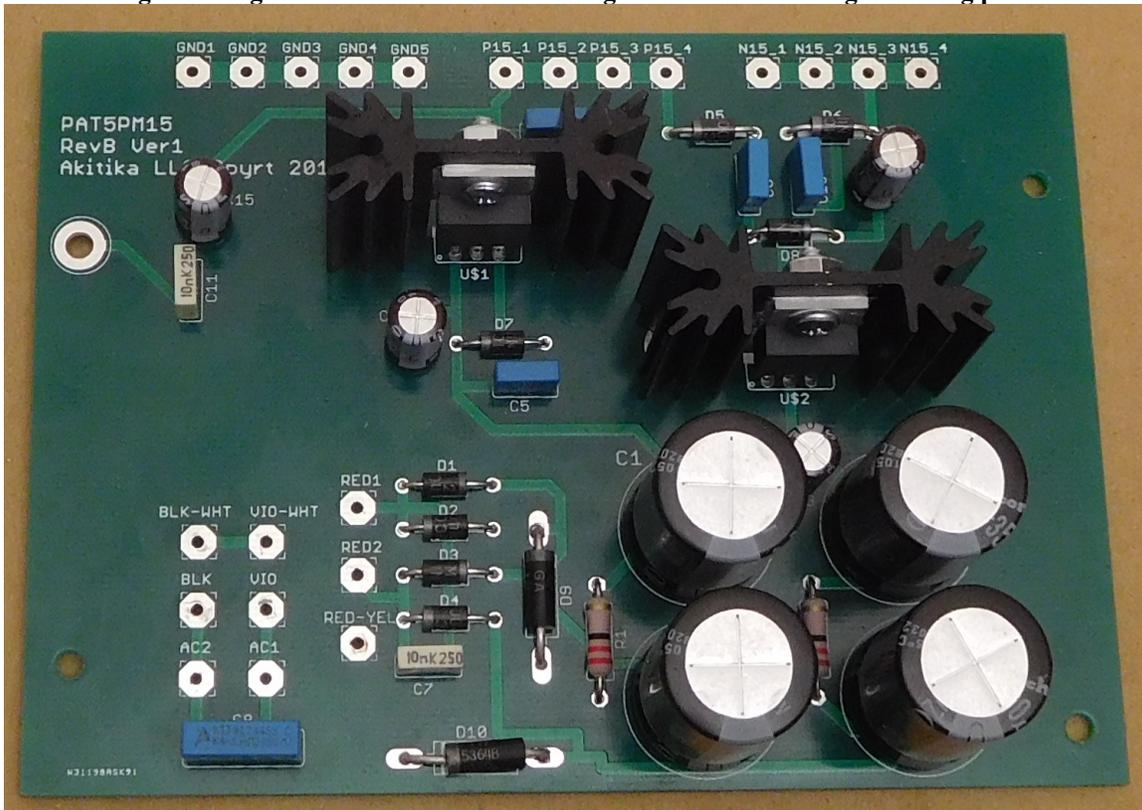


Figure 6-Assembled Power Supply

## Check your work

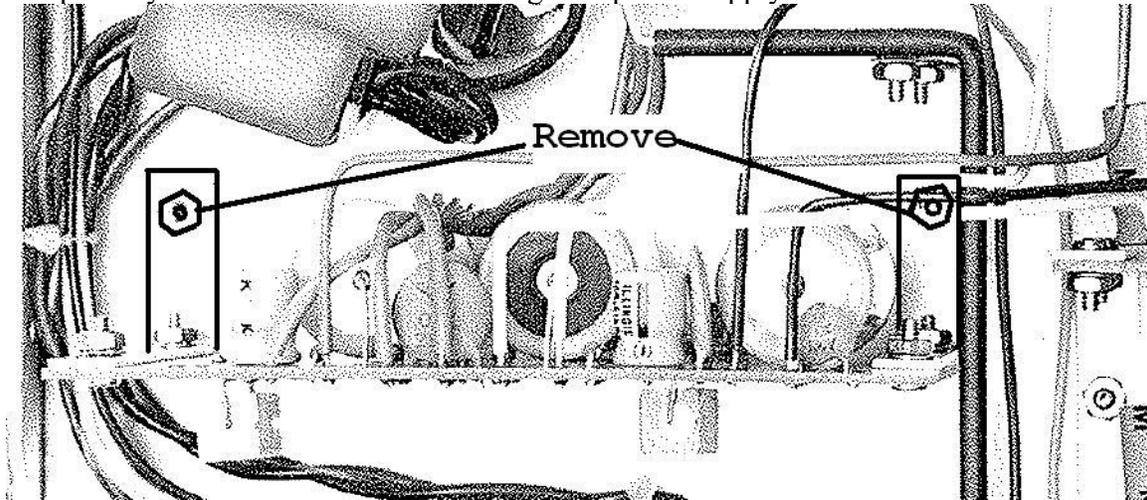
Look over the board to verify that:

1. All components are soldered.
2. No solder bridges are apparent.
3. Polarity of the electrolytic capacitors is correct.
4. The right regulator is in the right location.
5. The heatsink hardware is tight.
6. Diode polarity is correct.

If everything looks good, you're ready to install the power supply into your PAT-5.

## Removing the Old Power Supply

The mechanical design of the PAT-5 Preamp makes removing the old power supply a lot of work. Your soup bowl will come in handy again as a safe place to collect all the bits and pieces you'll need to remove to change the power supply.



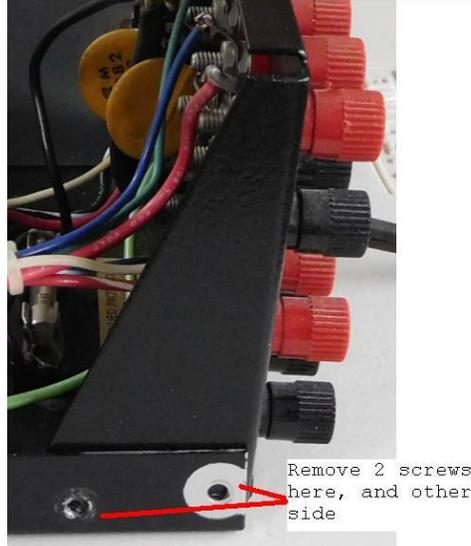
**Figure 7-Remove hardware that holds power supply bracket to chassis floor**

All of the following steps have the goal of removing the power supply and the power supply wall, allowing replacement of the old power supply with the new.

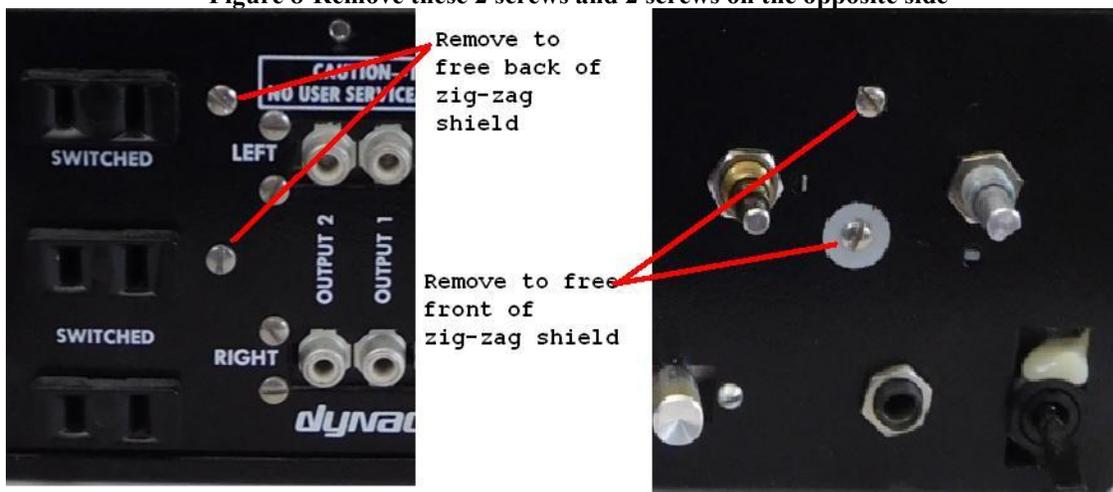
**Note:** You will re-use the 4-40 screws in your kit, so be sure to save them. However, we have supplied 4-40 keps nuts. A keps nut has a captive lock-washer. These keps nuts will replace the separate nuts and lock-washers originally used for PAT-5 assembly.

<b>Prepare to remove the old power supply</b>	
	Done? (✓)
<i>Pull the Preamp's AC plug and wait 1 minute before going on.</i>	
Remove the two screws (one in each bracket) that hold the silver colored power supply mounting brackets to the bottom of the chassis. Easiest access is from the screws at the bottom of the chassis (Figure 7).	
Remove the four side screws that hold the back panel to the bottom of the chassis. (2 along each side, near the back, see Figure 8).	

Remove the two 4-40 screws and nuts from the back panel that hold the zig-zag shield and the power supply mounting bracket. Try to not let the nuts or lock washers get away from you (Figure 9).	
Use a 1/16" Allen wrench to remove all the front panel knobs. I like to turn all the knobs fully counterclockwise before I start. It makes all the set screws available and give me a consistent place to re-set all the knobs when it's time to re-assemble the preamp.	
Remove the 3 nuts on the control shafts that hold the front panel in place. These are typically located on the input selector, balance, and speaker controls. Remove the front panel	
Remove the two 4-40 screws and nuts that fasten the front of the zig-zag shield to the front panel (Figure 9).	
Lift the back panel slightly to clear the lip on the bottom of the chassis. There is enough slack in the wires to move the back panel back a bit. That opens up enough room to lift out the zig-zag shield and power supply.	
Lift the power supply and zig-zag shield assembly out of the preamp.	



**Figure 8-Remove these 2 screws and 2 screws on the opposite side**



**Figure 9-Remove the screws and nuts that hold the zig-zag shield to back and front of chassis**

<b>Remove the old power supply</b>	
	Done? (✓)
Remove the four screws (two in each bracket) that hold the silver colored power supply mounting brackets to the old power supply PCB.	
<b>Disconnect Transformer wires from the old PCB</b>	
	Done? (✓)
Desolder the two red wires from the old PC Board.	
Desolder the Red-yellow wire from the old PC board.	
Desolder the violet and violet-white wires from the fuse holder.	
<b>Disconnect the transformer wires from the chassis</b>	
Desolder the black and black-white wires from their connection point on the convenience outlet. However, make note of this terminal as a wire will be reconnected here in a later step.	

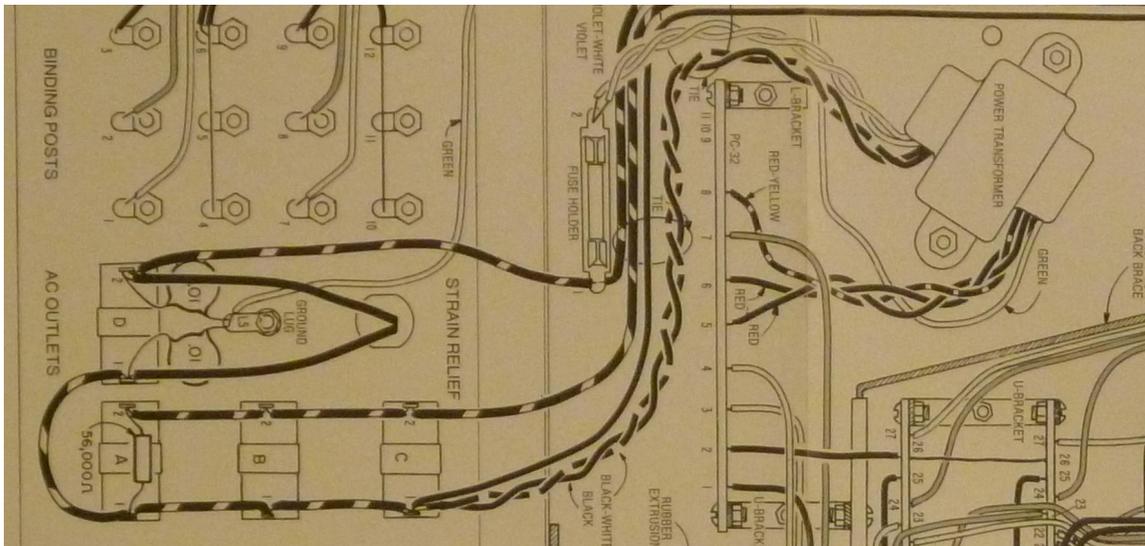


Figure 10-Original Transformer wiring

## Connect the Transformer

**Make absolutely sure that your PAT-5 is unplugged!**

You will re-use the original Dynaco power transformer. In its new connection arrangement, the total power drawn by the PAT5 drops from 10 Watts to 7 Watts. That's because the new arrangement is more efficient than the stock arrangement.

**When the new power supply is installed, except for the green shield wire, all of the transformer wires will terminate on the new power supply PCB.**

### Connecting the low voltage transformer wires

1. Identify the following 3 transformer wires
  - a. First red wire
  - b. Second red wire

- c. Red/yellow wire
2. Form the three wires into a twisted trio.
3. Insert the wires from the component side of the board and solder them on the solder side.
  - a. Either red wire may connect to RED1
  - b. The remaining red wire connects to RED2
  - c. The Red/yellow wire connects to RED-YEL

## Connecting the AC line-side transformer wires

Assuming your PAT5 was previously wired for 120V, you will find that:

- Black-White and Black transformer wires were twisted together
- Violet-White and Violet transformer wires were twisted together

As you perform the steps below, you will untwist these pairs, and form new twisted pairs out of these four wires.

### **Make absolutely sure that your PAT-5 is unplugged!**

1. Identify the following 2 transformer wires:
  - a. Violet
  - b. Black-white
  - c. Verify that you have the correct pair by measuring the DC resistance between these two wires. The DC resistance is around 120 Ohms<sup>2</sup>.
2. Twist these insulated wires together to form a new twisted pair. (Violet and Black-White) Of course, their ends remain independent.
3. Insert the wires into the component side of the board and solder them on the solder side. Leave the wires as long as possible, but if their lengths differ greatly, you will probably want to equalize them to the length of the shorter wire in the pair. Just make sure that it will reach when everything is put back in place.
  - a. Connect the Violet wire to the VIO eyelet on the PCB.
  - b. Connect the Black/white wire to the BLK-WHT eyelet on the PCB.
4. Identify the following 2 transformer wires
  - a. Violet-White
  - b. Black
  - c. Verify that you have the correct pair by measuring the DC resistance between these two wires. The DC resistance is around 120 Ohms.
5. Twist these insulated wires together to form a new twisted pair (Violet-White and Black). Of course, their ends remain independent.
6. Insert the wires into the component side of the board and solder them on the solder side. Leave the wires as long as possible, but if their lengths differ greatly, you will probably want to equalize them to the length of the shorter wire in the pair. Just make sure that it will reach when everything is put back in place.
  - a. Connect the Violet/white wire to the VIO-WHT eyelet on the PCB.
  - b. Connect the Black wire to the BLK eyelet on the PCB.

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<sup>2</sup> The resistance you find as you measure the DC resistance of these windings may vary by plus or minus 10% from the quoted value.

## Connecting AC Power to the PCB

**Make absolutely sure that your PAT-5 is unplugged!**

The only thing that remains to do is to connect the fused 120 volt power to the transformer. Locate the supplied piece of twisted white/black 22 AWG stranded wire.

1. Cut it to a 13" length.
2. On one end, untwist about three inches of the wires.
3. Cut off 3" of the white wire on that end.
4. Strip ¼" of insulation from the four ends of the wires. Twist and tin the four wire ends.
5. Solder the short white wire to the fuse terminal closest to the side of the enclosure. Recall that you removed the transformer violet-white and violet wires from this fuse terminal in a previous step.
6. Solder the black wire from that end of the twisted pair to the convenience outlet terminal (outlet C, terminal 1 in Figure 10). Recall that you earlier had disconnected the black-white and black twisted pair from this terminal.
7. Route the black/white twisted pair along the same path as was previously taken by the transformer wires, along the side of the chassis.
8. Insert the unconnected white wire into the AC1 eyelet from the component side of the board and solder it on the solder side.
9. Insert the unconnected black wire into the AC2 eyelet from the component side of the board and solder it on the solder side.

### What if PAT5PM Is Installed?

The transformer wiring changes in this manual puts the power transformer windings in series, rather than parallel. These changes are independent of the power switch re-wiring undertaken in the PAT5PM (Power on mute) manual. Therefore, the wiring for this power supply installation does not change if the PAT5PM is present or absent. In both cases:

1. power supply white wire goes to the side of the fuse closest to the side wall.
2. Power supply black wire goes to outlet C terminal 1.

The difference between PAT5PM wiring (switching the power to the power supply) and standard wiring (leaving the power supply always powered) remains independent of the changes described in this manual.

### Take a break

You have just reached a rather important milestone. Get up, walk around, say hi to your significant other or the family pet. You're about to apply power to the PAT5 to test the power supply, and it's always a good idea to have clear head before doing anything that involves the AC mains.

## Testing the New Power Supply

### Safety Warnings:

- Clean-up and make sure that no tools are inside the preamp. You're about to power it on to test the output voltages. **Remember to be safe, as potentially lethal voltages will be present in the next step.**

Re-installing the power supply is a lot of work. It's probably a good idea to test the supply before you re-install it. Follow these steps:

1. Make sure that the power cord is unplugged.
2. Fold a piece of 8.5"x11" paper in a U-shape around the bottom and sides of the power supply. The idea is to form a temporary insulator that will keep the PCB from making electrical contact where it should not.
3. Set the combination of the power supply and paper temporary insulator into the chassis, close to its normal position.
4. Look at the arrangement to make sure that nothing from the power supply can contact the chassis. If necessary, **add a second piece of paper.**

**Be Careful. The next step makes 120Volt AC accessible inside the unit.**

5. Plug in the power cord and turn on the power switch. Stand back and look for a minute. There should be no excitement. Pull the plug immediately if you see evidence of smoke or fire. If all is calm after 1 minute, go on to the next step.
6. Measure the DC voltage from any of the P15 terminals to the GND terminals. It should be 15+/-1 Volts.
7. Measure the DC voltage from any of the N15 terminals to the GND terminals. It should be -15+/-1 Volts.

Pull the plug from the AC wall socket (mains). If the voltages were correct, go on to the next section. If the voltages were not correct, then examine your board for missed solder joints, backwards diodes, missing components, backwards capacitors, swapped regulators, and the like. There is no point in going on until the power supply is functioning correctly. If you get stuck, send email to [dan@updatemydynaco.com](mailto:dan@updatemydynaco.com).

## Installing the New Power Supply

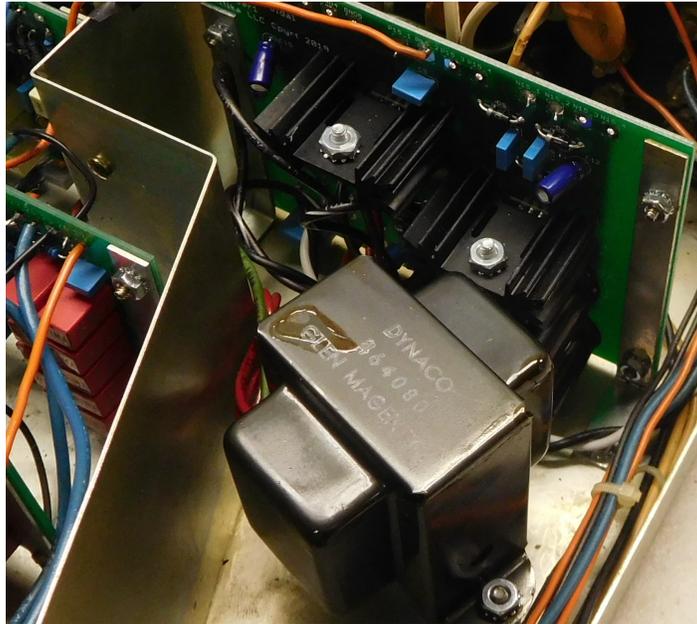


Figure 11-Mount new PCB to shield and mounting brackets

<b>Installing the new power supply</b>	
	Done? (✓)
<i>Pull the Preamp's AC plug and wait 1 minute before going on.</i>	
Mount the new power supply to the zig-zag shield using four 4-40 screws and the supplied 4-40 KEPS nuts into the power supply mounting brackets. KEPS nuts, with their captive lockwasher makes reassembly easier. Figure 11 shows the correct order of the brackets, PCB, and screws.	
Use two of the silver colored 4-40 screws and supplied 4-40 KEPS nuts to fasten the power supply mounting brackets to the bottom of the chassis.	

## Complete Zig-Zag Wall and back panel re-Installation

<b><i>Make sure that the PAT-5 Preamp is unplugged before going on!</i></b>	
Use two silver colored 4-40 screws and the supplied 4-40 KEPS nuts to fasten the zig-zag shield to the front panel. It's hard to get your fingers in place to hold the nuts. I like to hold the nut in place using double sided tape wrapped around the blade of a flat screwdriver. I then use a second screwdriver to turn the screw.	
Re-use the four (2 on each side) ¼" hex head self-tapping screws to fasten the back panel to the chassis bottom. Make sure that the back panel sits just inside the lip on the bottom of the chassis.	
Use two silver colored 4-40 screws and the supplied 4-40 KEPS nuts to fasten the zig-zag shield to the back panel.	

## Re-connect Power Supply to Preamp and Phono Sections

***Make sure that the power plug is pulled before proceeding.***

The big picture is this. We want to reconnect +15V, GND, and -15V from the power supply to the phono preamps and line stages. Follow the following color code if you use the supplied wire:

- Black is Ground
- Red is +15V
- Blue is -15V

There are a number of ways you could do this. The follow pictures sketch the variations. We assume in both sketches that you have followed the standard directions for the preamp and phono sections, where the left and right channels of each set have their powers and ground connected by jumpers between the boards.

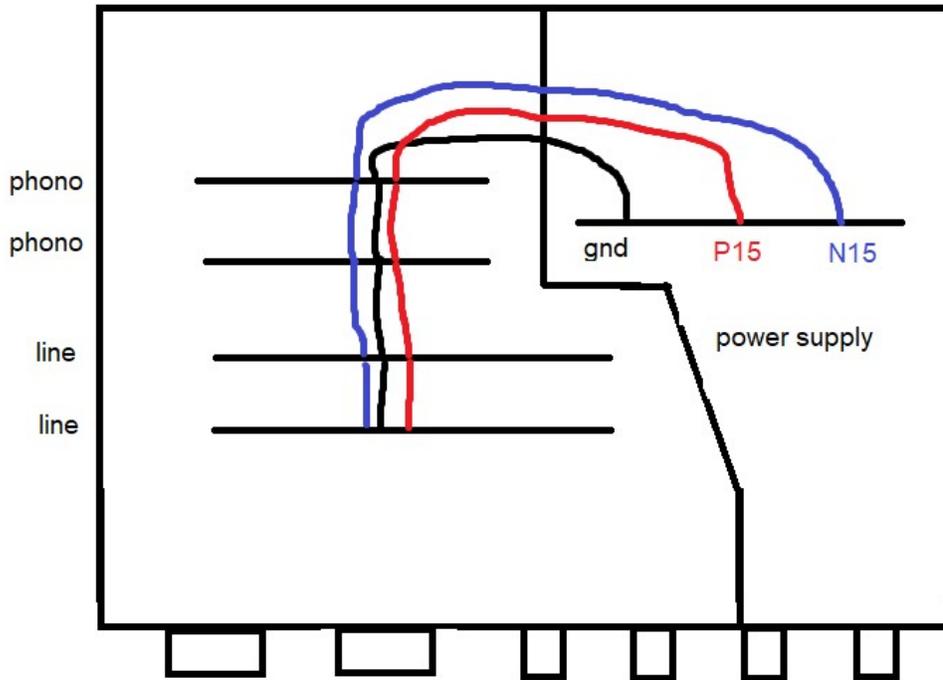


Figure 12-wiring power from back to front with jumpers

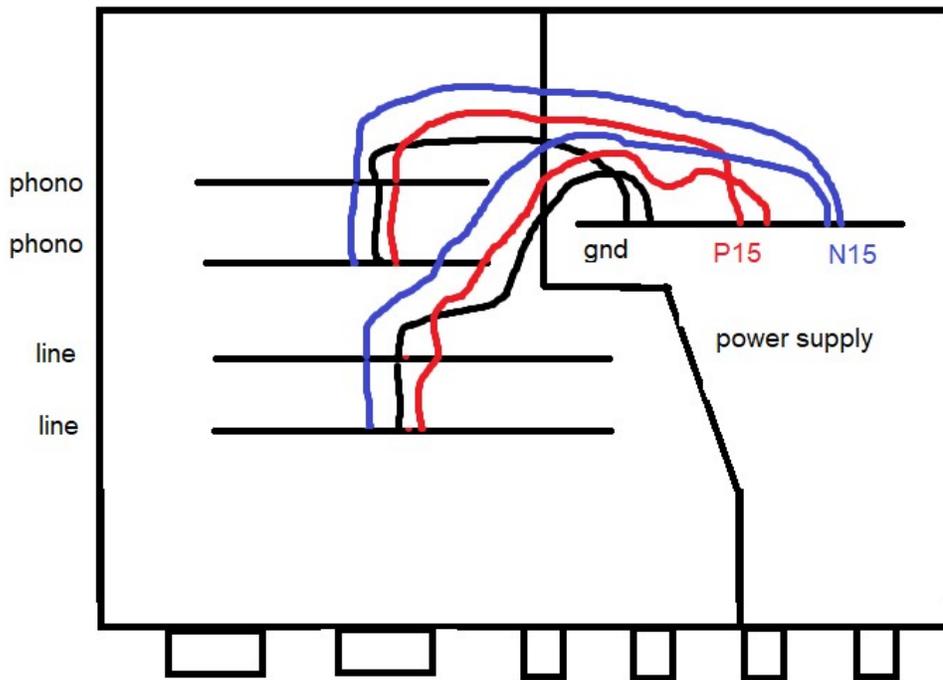


Figure 13-Separate runs for power to phono stages and line stages

## Testing the Power Supply Line-Stage Combination

<i>Be safe as you plug in the AC cord. Remember that lethal voltages will be present inside the preamp.</i>	
Verify that the power supply output voltages are still in tolerance after connecting the power supply to the rest of the preamp.	
Measure DC voltage from any of the P15 terminals to any of the GND terminals. It should be 15 Volts, plus or minus 1 volt.	
Measure DC voltage from any of the N15 terminals to any of the GND terminals. It should be -15 Volts, plus or minus 1 volt.	

## Final Re-Assembly

Once you have verified correct voltages, it's time to return your PAT-5 Preamp to service.

<b>Putting on the Cover</b>	
	Done? (✓)
Place the cover on the preamp. Note that there is only one correct orientation. You'll see the 4 holes on the sides line up when the orientation is correct.	
Install the 4 black screws (2 on each side) that hold the cover in place	
Install the black screw that holds the center-back of the cover to the back panel.	

# Schematic

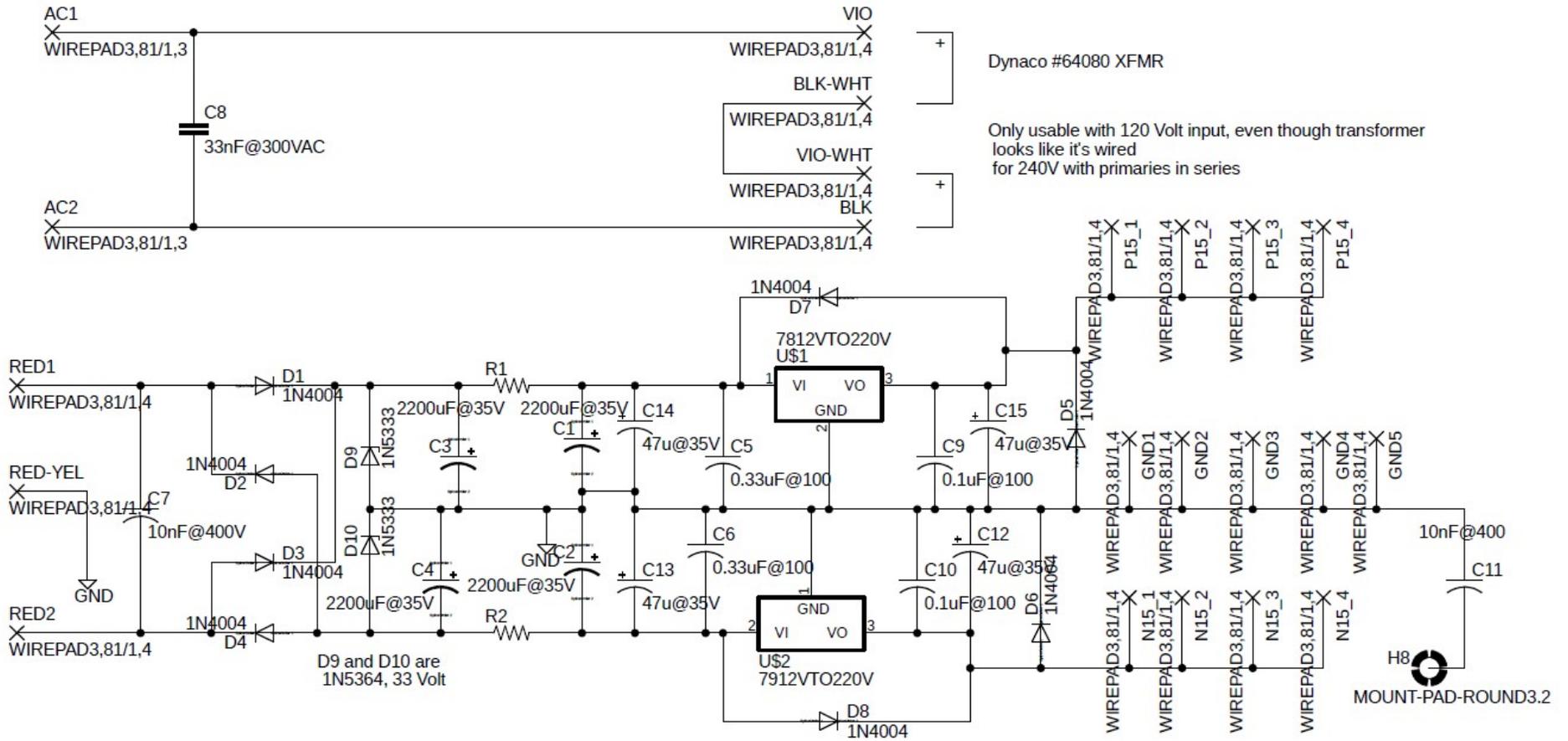


Figure 14-Schematic of Power Supply